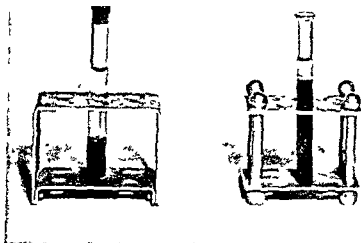


Tubes and racks

Measuring the effect of reduced pressure on sedimentation, especially barometric (weather) and aviation changes

THE

SEDIMENTATION RATE

OF

HUMAN ERYTHROCYTES

ITS BASIC CONCEPTS

ITS VALUE AS A DIFFERENTIAL DIAGNOSTIC AGENT.

ITS MULTIPLE CLINICAL APPLICATIONS.

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NEW YORK

VANTAGE PRESS

WASHINGTON • CHICAGO • HOLLYWOOD

FIRST EDITION

Published by Vantage Press, Inc
120 West 31st Street, New York 1, N Y

Manufactured in the United States of America

Library of Congress Catalog Card Number. 58-10678

To

My faithful colleagues
who have collaborated without remuneration
and who have, at times, given funds
to tide me over the rough spots

PREFACE

I believe the sedimentation rate has great value the extent of which has not been recognized

Do you?

Do you use it?

Do you really believe it aids in solving your problem?

Why is it used in most hospitals the world over?

What, in your mind, do you think it really is, and what may it do?

Do you think it might interest nonmedical men and the public at large?

Why has it been called a rate when it is measured in distance, often in millimeters?

This valid question trigs off a chain of replies which show the utter uselessness of the method now in vogue

In the first place, it is basically unsound, and all calculations stemming from it are worthless

What is this seductive misconception? Answer The centuries-old error of taking as a *norm* the suspension stability of corpuscules in uncoagulated blood

Next, why is it used? Because the misleading chant of "short, shorter, shortest" is accepted as the answer Incidentally, it fills up a line in the so-called "work up" of a case Beware of shibboleths and eponymic diseases!

What then is a properly performed sedimentation rate? Answer It is an accurate measure of *energy at work*

Energetics is a term very difficult to define To measure energy at work is even more difficult and of greater importance, *but we can do it*

Thus we can tell whether energy is being acquired and if so, whether it is being stored or expended Later I will speak of the normal utilization of energy and the normal sedimentation rate

What is more important and more useful is that the rate lets us measure *any form of energy, either radiation energy or that acquired from food*

The relationship between the fall of the cells and energy was found clinically when the long sedimentation rate was noted in the blood of allergic individuals

We knew very little about energetics then, and still used the term allergy very widely, applying it to sensitivity to substances *touched, breathed, or swallowed*

Absence of or diminution in the amount of energy naturally followed, and we recognized it as a very important factor in the clotting of blood at the abrupt turns of the vessels, notably in the brain and heart (See Introduction)

But to this day we are handicapped by the fact that we have no single word to explain the presence of a low energy content and none to describe the excess, or high energy, content

Energy rich "$\sim$" is the only term, but it gives no idea of *how rich*

Fortunately we can measure both long and short sedimentation rates by the use of a suitable tube, a suitable *anticoagulant (sodium citrate which does not upset the* Krebs or citric acid cycle)

When energy is lost we have a shortening of the sedimentation rate (The fall is more rapid)

As energy is regained the rate lengthens toward normal. By *normal* I mean energy sufficient to maintain all bodily functions such as weight temperature organ activities water balance and the like

This becomes a physiological constant and is often maintained at approximately the same figure for years—an encouraging sign of good health

From this point on when the time begins to lengthen it means storage of energy beyond the need for maintenance It is often caused by repeated exposure to allergens or to low grade chronic infections such as are harbored in the gut

It was this that taught me about the allergy of infection Still later I learned of irritants called carcinogens which promote growth—such as for instance the pipe-smoker's lip cancer

A final and important question Do you think this energy measurement is of interest outside the medical profession—I mean to the public at large? The answer is definitely Yes

Because of Pearl Buck and the crew of the *Lucky Dragon 5* the test its methods and the safety measures afforded individuals exposed to radiation will be found in every library in the Orient

The three best organized and best publicized groups in America have to do with *energy at work* and all three have need of the sedimentation rate to measure it

Energy in action This phase includes the rhythmic muscular activities of the circulatory and respiratory systems

Energy in substance As living protoplasm here one of its main functions is growth promotion

Excess energy promotes excess growth—often ill directed

imity to still active undisposed-of by-products) Other sources are radiodiagnosis during pregnancy (fetal position or number) or hypernutrition before and during pregnancy

Once the growth has reached the cell wall or tissue boundary, it ruptures through because of excess growth pressure or some proteolytic enzyme such as chymotrypsin or Krebiozen Once through, the particulate matter is taken up by the wandering or mast cells, if viable is transplanted far afield—and the patient is found full of cancer

Other enzymes differing in power and potency often, when reaching the dermal boundary, produce only a non-viable exulcerating area These have no power to metastasize, but through the lytic action upon the blood account for the emaciation called cachexia Here the sedimentation rate is always rapid

In the patient with carcinoma of the stomach, one available and very potent enzyme may so retard and digest the malignant mass that the patient leads a symptom free *charmed life until it is abruptly terminated* The cause a perforation through which gastric content, blood, digest, and *debris spill into the peritoneal cavity*

To date, the point at which the enzyme can be stopped is not known, but gastroscopy may give *information from* the inside and half soling with a fascial transplant may pro tect from the other side

Lastly, there is the scourge of the *leukemias, affecting* young and old, and usually fatal Progress is rapid and death early

Let me recapitulate There are two types of cellular nuclei, one of which is practically unknown to tinctorial hematologists This has a nucleus the *albumin* of which is

practically the same as the albumin of the surroundu
plasma

Viewed in the dark field, the nuclear area looks like :
apparently empty hole The cells with these nuclei are your
cells and very responsive to adverse energy, particularly fro
the intestinal flora, which is always bad The process
acute, both cells and plasma being lysed The cell cou
in acute leukemia is not high, being only the residuum of tl
acid bearing nucleated cells This paucity of stained ce
results in an aleukemic state and accounts for the so-call
aleukemic leukemia.

One prominent person made the rounds of the cel
brated hematologists abroad, came back with a diagnosis
bastard leukemia—and died soon afterward

Here the sedimentation rate is rapid and there is no stc
age, nothing but *loss* of energy

The *chronic lymphatic leukemias* These are diametrical
opposite The nuclei are filled with nucleic acid and store :
immense amount of energy

The type of cell is only an artificial classification, d
pending upon staining

In some cases the sedimentation rate has reached tl
most unusual time of twenty eight hours, which tells the e
tent of energy stored It also tells us why these patients wit
stand the terrific onslaughts with nitrogen mustard ai
Myleran

Distribution through the thymicolymphatic system a
counts for the wide dispersion—glands and skin are exampl

The energy *stored* in the glands gets the name of lymp
osarcoma because it is of connective tissue rather th:
epithelial origin, and, being in the lymph glands, why n
lymphosarcoma? The name is logical and deadly—but us
less

Curiously, some chronic leukemic patients feel best when the white count is very high

Stored energy may be the answer

To close as I began I still believe that the sedimentation rate properly used has not only great value but possibilities as yet unheard of

F W

CONTENTS

With God's help Who permitted a glimpse
of His wondrous powers

INTRODUCTION

QUO VADIS, DOMINE?

THE same energy which brings leaders and executives to their positions reacts adversely to their changed and ever changing environments

The accuracy of the National Safety Council's predictions is surprisingly uniform, and we have its counterpart in the safety idea in medicine

The Council was the outgrowth of plant engineering by a man whom I met at Chicago Memorial Hospital This hospital was of homeopathic origin, and the adage, "Like cures like," influenced all of us He was a safety man first, last and all the time He envisioned safety in a broad sense

Why not extend the safety coverage afforded the factory, farm and road workers to the higher ups?

These would include officers and directors—in fact, all executives who supply the energy to amplify and promote enterprises

He came to me, a clinician and teacher of colloidal chemistry, with these questions

"Was it feasible to include officials?"

I answered, Yes

"Would I go along with the project?"

I answered, Yes

After considerable thought and planning he sent two of his own top men to me for study

As this was an energy exchange proposition, I added to the usual *pulse, temperature, respiration* and *blood pressure*, the *vital capacity*, with *Lung Capacity* before and after deep breathing to rid the lungs of CO_2 (an important means of testing endurance)

The physical triad of mutually confirming facts, the sedimentation rate of the blood plus viscosity and refracto metric index of the serum, were made at frequent periods of time

The results all led to that dangerous setup—hemoconcentration This in turn can be readily measured

This posed the safety idea—a low blood pressure, a thick *blood with a predilection for stopping at any spot where the* circulation is angulated and slowed The spots are frequently in the coronary and cerebral vessels

We are all acquainted with periods of low tension—the deep sleep from which the individual does not waken—at a high altitude, as in the mountains or airplane trips (often in spite of pressurizing facilities), emotional—the elderly speaker after a heavy anniversary dinner

Hypertensive blood pressure readily exhibits its devastating consequences, but when the hypotensive individual, with sensitivity to change in environment is examined, watch out—be alert and make repeated examinations

Hardly a large organization or family survives a year without the sudden loss of a supposedly well and usually much needed man

Forewarning will save many lives, for treatment is very efficient!

Chapter 1

SCOPE AND PURPOSE OF THIS STUDY

Scope and plan I will show that the fall of the blood corpuscles in a noncoagulated blood is an energy reaction exchange Further I plan to show how to measure energy acquired and energy spent

Still further, I plan to show how energy is acquired and stored normally In contrast, I will demonstrate how it can be acquired and stored abnormally

It follows that the release of energy at a normal rate in health can be measured As such, it becomes a physiological constant, and as long as maintained, it is a staunch indication of health

But when the energy is released in abnormal amounts or at unusual rates, the results are of great value to the astute clinician

Purpose Once the role of energy transfer is recognized as playing a major role in the physiology and pathology of the human body, I plan to show how certain symptoms result from this energy-release exchange

If the patient has fever, the loss of energy as heat, or its secondary release by sweat, is self-evident.

How often does a patient inquire, "How can I be so sick —I have no fever?" In this booklet I plan to answer some of these questions.

The group making up this McDonagh Society consisted of Dr Ernst Pribram and Albert Zrunek (both since dead), Kamil Schulhof, and myself As we compared notes, it was soon impressed upon us all that slow sedimentations occurred in the bloods from allergic individuals Some were of the hay fever, asthma type, some from atopic individuals, and here we learned about the allergy of infection

With these examinations we also included ultramicroscopic or dark-field studies of the kinetic activities of both sera and corpuscles, more than that, we very carefully made a series of movie films by which we could project the activities greatly enlarged, thus permitting a careful study of the different phases of blood metabolism

About this time Schulhof and Pribram both published papers on the sedimentation rate as being slow in allergy but taken alone, they did not present a convincing picture

In October, 1933, I published a paper entitled, "Micrometabolism and Its Clinical Application"

By incorporating this paper, which is essentially as correct as when written almost a quarter of a century ago, a framework will be established in which to fit some of the added facts and make clearer the part that sedimentation plays

It was this coupling of the energy loss and recapture with the shortening and lengthening of the sedimentation rate that proved that the rate was an energy exchange measurement But why did we find long sedimentation rates in the allergies? In time we found that exposure to adverse agents for a prolonged period provoked the formations of antigens which accumulated as the adverse agent continued its activity until a large amount of energy was stored

This gives the measuring response of long sedimentation

until by some means the release is trigged off, either slowly or explosively, producing the symptoms we call "allergic manifestations."

Chapter 3

MICROMETABOLISM AND ITS CLINICAL APPLICATION

To the clinician, "metabolism" is a broad term, describing tissue activities whereby growth occurs, function is maintained and waste products discarded Anabolism describes the constructive, catabolism the inverse or retrograde, phase, the algebraic sum of the two activities representing the metabolism While certain disorders are called "metabolic diseases" and the term "pathologic metabolism" is used, there is still a feeling that the disordered metabolism, in a general way, is associated with the disease rather than constituting the disease itself

Patients in whom catabolic activity predominates often show gross manifestations, such as loss of weight, fever, acceleration of the pulse rate, glycosuria, hypertension or increase in the metabolic rate as measured by the oxygen consumption While the interpretation of these predominating findings engrosses the attention of the physician, a host of antagonistic or defensive mechanisms are being mobilized These constitute the anabolic response, and while for a time they may give no outward signs nor definite symptoms, later, particularly when they predominate or localize, they are responsible for many pathologic manifestations The regula-

tory mechanism of the tissues, tissue fluids, lymph and blood is so comprehensive that excess catabolic activity in one area *is compensated for* by an active anabolic reply in another, and a confusing clinical picture results Moreover, because of their constructive characteristics, these anabolites tend to accumulate in the body fluids and are, in part, eventually deposited *in the tissues, particularly those in which circulation* is retarded, oxygen tension is low, or where previous injury or pathologic changes have lessened cellular activity Many *results of focal infection are examples of this perverted ana* bolic activity, the deposited products inciting vicarious response

Closer study of tissue activity is desirable, but of neces sity must be made by indirect methods applicable to the blood, which most closely approaches the tissue fluids and transports the various metabolites

By the use of several well established methods, first util ized extensively by McDonagh, of London, a very rational concept is obtained concerning many disease processes which have heretofore been baffling As the ultramicroscope or dark field examination of the serum is used, the term *micrometabolism* is coined, because it gives a more intimate insight into the visible activities of the colloidal particles of the serum and of some of the cells Physical measurements are utilized, *together with chemical estimation of the* metab olites, with the result that both anabolic and catabolic proc esses can be quantitated

Clotting, Sedimentation, Refractility and Viscosity

Venous blood from the arm is drawn with a dry syringe and with minimum negative pressure When allowed to co agulate, the appearance and size of the clot and the quanti

ty and color of the serum often indicate the predominating activity of the organism A small retracted firm clot, with a relatively large amount of highly colored serum, is often found where catabolism predominates In extreme cases, lysis of the erythrocytes results in a reddish serum On the *other hand, where anabolism rules, the clot is large gelatinous,* does not retract well and the serum is scanty and light colored

The sedimentation rate, long forgotten and again brought into use, becomes more valuable as an adjunct measurement of metabolic intensity Rapid in acute infection or intoxication, it is likewise rapid in carcinoma with metastases Its rapidity is associated with metabolic overactivity, as in fevers a prolonged sedimentation rate is comparable to the period of hypothermia which follows fever This difference should be emphasized, however—that the return of the sedimentation rate to normal is much slower than that of the temperature, and the prolonged sedimentation rate (a sign of anabolism) may follow months afterward A lengthening of the sedimentation rate is found in many allergic states

The refractometric index of the serum, obtained after allowing the venous blood to clot at room temperature in a dry, sterile container, using preferably the Abbe refractometer, provides a physiologic constant comparable to the pH of the blood and the temperature of the body Coupled with this is the estimation of the viscosity of the serum, for clinical purposes by means of the Hess laboratory type viscosimeter at a temperature of 25° C By these measures we estimate the relative amount of protein and its state of aggregation

Acute lysis (catabolism), resulting from infection or intoxication, depresses the refractometric index (RI) by sending some of the proteins into solution Not infrequently the

viscosity (V) is lowered to an even greater degree than the *RI* *because the* protein *particles* are smaller and their water envelopes are less marked As the size of the particles and the thickness of their surrounding adherent water covering regulate the viscosity (*the greater the size and the larger the* envelope the more viscid the serum) it is logical to infer that any lytic process will affect the surface of the protein particles earlier and to a greater degree than the central portion As the viscosity depends upon these more external factors and the refractometric index upon the amount of protein and number of particles this may explain the frequent disparity between the two indexes This has been worked out by Schulhof of Chicago who has evolved the V/R index which is normally 100 less if the viscosity is diminished to a greater degree than the refractometric index *above 100 if* the viscosity is higher in proportion to the RI As an aid to prognosis and in the management of both acute and chronic infections this is a most valuable aid

The ability of the blood to maintain its integrity is remarkable as shown by its retention of chlorides when hoarded by a pneumonic lung its remarkable acid base mechanism its almost constant pH and its conservation of protein together with sufficient water to maintain an osmotic pressure compatible with life In the presence of long continued intoxications or infections especially *those* due to *Gram* negative organisms the anabolic response is most marked The globulins and lipoglobulins predominate They adsorb *metabolites* bind water are inseparable from many antitoxins and are involved in most immune reactions They are less soluble and more easily precipitated than albumins and because of this ease of precipitation often instigate secondary pathologic processes Eventually the effect upon the refractometric *index is* to *raise it* *the* viscosity increases frequently

proportionately more than the RI, in which case the V/R index of Schulhof is greater than 100

Dehydration and Hydration

The separation of water from, and the addition of water to, the proteins prompted McDonagh to use the terms "dehydration" and "hydration" While convenient, they do not convey the broad idea that, together with the separation and attachment of water, a large number and variety of metabolites are also being detached or conjoined He makes this very clear in his various texts and, while workers in this field criticize his terminology, they find it difficult to substitute better terms

It must be kept in mind while estimating the gas content (O and CO_2), the bases and acid radicals united with them, such as Na, K, Ca, Cl, PO_4, and the important organic blood constituents—glucose, urea, uric acid, creatinine and lipoids—that during the catabolic phase these may be separated from blood protein and tissues along with water, the protein substrat even undergoing lysis, the fats saponification, and even the bones losing their mineral content Here the products of tissue, organ and blood activity are on the way to the port of excretion

When the anabolic cycle predominates, some of these substances which have been detached from one area unite with the lipoglobulins and are finally absorbed in another field Our bodies are conservative, and second hand metabolites undoubtedly enter into many of our organs A single injection of insulin cannot only lower the amount of free glucose in solution in the plasma, but diminishes the lipoid content and calcium by turning them back into combination with the protein of the blood and eventually the tissues

The blood stream is a multilane highway, with traffic in both directions Evidence of this may be found even in *venous blood, in which excretory* products naturally predominate When lysis, dehydration or excess catabolic action predominate, the amount of one or many of the various me*tabolites is usually above the average* When anabolism rules, the blood proteins become hydrated, metabolites are adsorbed, and estimations of those remaining in solution show figures for some which are less than usual The rise and fall of these values are not necessarily concurrent A low figure for glucose (an anabolite) is frequently found with a heightened urea finding, or a rise in calcium with a lowered phosphorous content

The question arises whether there is any visible evidence *that the proteins undergo any of the changes mentioned* above Here I enter a controversial field, but study of the serum in the dark field, by means of the ultramicroscope, provides a wealth of information The astounding activity seen emphasizes the fact that blood is truly a living tissue and that the plasma is more than an inert medium for the transport of cells and a solvent for the other constituents Moreover, the trend toward solution or lysis, on the one hand, or aggregation on the other, is illuminating, particu*larly because it furnishes a rational explanation for many of* the measurements applied, as enumerated earlier

In stained smears, platelets are found, the origin of which *is indefinite, having shapes which suggest pinched-off rem*nants comparable to the dough left when a housewife cuts out cookies Whatever their source, they are collections of coarse colloidal particles, they tend to form aggregations and they are usually present in the number of a quarter-million per cubic millimeter They stand midway between the cells and the colloidal aggregates seen in the serum when

examined under the ultramicroscope Cells and colloidal particles in the dark field frequently assume shapes similar to those of the platelets

The Protein Particles

Serum from normal persons, examined a few hours after coagulation has taken place at room temperature, when viewed in a dark field with intense light, shows myriads of colloidal particles in active Brownian motion If leukocytes are present, the granules of their protoplasm exhibit this same activity

The objection has been raised that freshly drawn blood does not show this motion, nor does the first serum which exudes from the clot manifest as great activity as it does later, hence the finding has no relation to conditions inside the blood vessels While this is true, we must not lose sight of the fact that coagulation clarifies the blood as egg does coffee Not only that, but the coagulation removes a large proportion of very active protein, the fibrin As the serum is expressed from the clot, the still living proteins again take up their activity and show again their tendency either to go into solution or even further to induce gelation if the catabolic urge is great, or to form larger particles, brighter because of their greater lipoid content, and sluggishly motile if the anabolic influence is greater These particles tend to huddle, agglutinate, form larger aggregations and to precipitate, either individually or in masses The picture is a changing one, but the tendency toward lysis or aggregation persists

To recapitulate, then, by examination of the blood or its serum we may find either a process, catabolic in nature, evidenced by small protein particles, losing their Brownian mo

tion, going into solution leaving only a haze or cloud, or sometimes simulating gelatin The sedimentation rate is short, refractometric index, viscosity and V/R index below average, and one, several or many of the metabolites excessive in amount

The converse picture appears where anabolism is provoked, the ultramicroscopic picture showing larger, slowly moving particles, which are brighter, often ring like or with halos, huddled, agglutinated or precipitated, sedimentation rate lengthened, refractometric index, viscosity and V/R index greater than average, and one or several of the metabolites found to be less than normal when quantitated

The two processes go on simultaneously and many factors influence the findings, sometimes producing a confusing picture There may be a selective activity involving one of the chemical constituents more than the others (as glucose), or excretion of these chemical compounds or of water may alter their concentration The lipoglobulin fraction may be deposited in the tissues and only the low chemical percentages or the high physical measurements remain to guide the clinician A series of examinations is of utmost value in estimating the rate and degree of the pathologic process and the influence of therapeutic efforts toward its correction Even more valuable is the evidence which tells when to terminate treatment and so prevents overmedication

Clinical Applications

In our daily work we are enabled to understand the action of many therapeutic agents by watching their effect upon the blood The whole group of antipyretics affects the colloidal activity, often only temporarily In prolonged infections due to staphylococci, manganese butyrate or symmetri

cal compounds of urea, when injected, restore more normal activity to the proteins, with resulting cure of the focal lesions Preparations of tin, by mouth, and aluminum potassium nitrate externally, often effect similar results Quinine is of value not only in malaria but in pneumonia and influenzal infections, where it restores electrical changes lost by the protein particles It exhibits a similar action when it modifies the pulse rate in hyperthyroidism, and the effect of an allied substance, quinidine, upon a fibrillating heart is still another example

Many drugs increase catabolism and elimination As long as the store upon which they draw is sufficient, they produce satisfactory results, but when it becomes exhausted, they accelerate the catabolic phase of the disease and are then not only detrimental but dangerous *Digitalis*, the sheet anchor where a decompensated heart requires support, works best when water retention is present It does not slow the pulse rate of hyperthyroidism and often fails in the myocardial insufficiency of pneumonia, because of the excessive metabolism already existent. If the dose is pushed beyond the point of tolerance, toxic effects, which are the result of acute dehydration, follow Nausea, coupling of the beat and heart block may subside if the drug is discontinued, but every clinician knows the danger which is imminent were he to give digitalis intravenously, while such symptoms were present or switches to another active dehydrating drug, such as scillonin When the RI, viscosity and particularly the V/R index are low, dehydrating drugs must be used with utmost caution, if at all This applies to the use of isotonic salt and glucose solutions in surgical conditions, because they too have a dehydrating action

A patient is subjected to a surgical operation This may be necessary in the presence of, or as a result of, infection, at

any rate, lytic agents influence his condition An anesthetic is administered more lysis is provoked Following the operation, salt isotonic solution, glucose and digitalis are administered, all being dehydrating agents When the proteins of the blood and tissues no longer tolerate this succession of catabolism provoking agents, there result *postoperative fever*, failing circulation, and, not infrequently, intravascular coagulation *If this occurs in the lung it is apt to be called* postoperative pneumonia or, if extensive, it may produce *massive collapse of the lung*

The value of a large number of commonly used drugs depends upon their dehydrating action, and when administered beyond the point of tolerance, transforming the hydrated proteins of the blood into a state of dehydration they *produce unwelcome symptoms Best examples are nausea* and vomiting, drug rashes which follow bromides iodide and barbital preparations, jaundice or extensive liver damage after cinchophen, and neuritis after arsenic or emetine A celebrated neurologist at Saint Elizabeth's hospital remarked several years ago that syphilitics treated by using mercury and iodides developed general paresis some twenty years after their infection, but after the more intense arsenical *treatment he found the* elapsed period much shorter and many full blown paretics were being admitted seven or eight *years after their initial lesion*

The various uses of ipecac are of interest As the syrup *it is still a household remedy in croup* combined with opium, in Dover s powder, it was for years a much used drug in common colds, until *narcotic regulation and new organic* preparations eliminated it Today, as emetine, it finds its use in amebic infections and colon disease, *and is being incor*porated into a proprietary preparation for treatment of gastric ulcer

Even the effect of common salt is being better understood in its relation to metabolic activity Long known to *influence edema its relation to many skin lesions, when used* to excess or without other counterbalancing minerals, directs the interest of the internist toward dermatology The need of salt in conjunction with corticin opens a new chapter in the relation of colloids to disturbed physiology.

The liberation of erythrocytes into the peripheral circulation in pernicious anemia, by administration of the recently *discovered addisonin* is an example of specific response to metabolic stimulation Similar but less successful results have been obtained in granulopenia by the use of pentanucleotides and yellow bone marrow It is of interest that, in one condition, the active granule containing cells are missing and in the other that the newly delivered reticulocytes differ in colloidal structure when distorted by certain *strains* The appearance is quite the converse of that known as "cloudy swelling"

Of *the* therapeutic agents affecting anabolism, iletin is *the outstanding example Because of its source and effect* upon blood glucose and glycosuria, the greater *range* of its activity was more slowly *appreciated* Insulin edema, typical tissue hydration and the restoration of the obesity which so often precedes diabetes emphasize its action upon water and fat metabolism Insulin convulsions are comparable to those of epilepsy, cerebral syphilis or whisky fits, all associated *with acute hydration of the brain In the past few* years the term "hyperinsulinism" has been applied to a syndrome which is, in reality, the result of perverted anabolism

The use of insulin in tuberculosis, hyperthyroidism hypertension and to aid or replace viosterol in the fixation of calcium in osteomalacia, is often followed by gratifying re-

sults A preparation having less prompt but more prolonged anabolic action will probably supplant it in some states where vascular lesions predominate This is the so called "tissue extract," obtained from blood, muscle or pancreas and having properties distinctly opposed to those of suprarenalin

An appreciation of the metabolic responses of the sick, particularly if supplemented by micrometabolic study of their blood, will aid the physician in restoring them to normal

Cancer is unquestionably the most extreme example of metabolism at the crossroad On the one hand, the neoplastic mutiny of cells, primarily a growth response and not a de generation, progressing until the cellular aggregates are crowded through their limiting membranes and free to be transported to new territories, on the other hand, the excess catabolism which, unable to compensate the strain imposed upon it, finally results in cachexia and death —Reprinted from CLINICAL MEDICINE AND SURGERY, Vol 40, No 10, October, 1933

Chapter 4

TOWARD A BETTER UNDERSTANDING OF THE SEDIMENTATION RATE OF HUMAN ERYTHROCYTES—AN ENERGY-EXCHANGE PHENOMENON

Since I learned of the energy transfer involved in the fall of the erythrocytes by studying the sedimentation rate, I find the following methods, while not perfect, the most satisfactory in determining that rate

I *The tube* This is 7cm long, 7mm in diameter, and the 0 mark is so placed that it measures 1.2cc of fluid This is approximately 18mm from the top of the tube Four lines are marked at 6–12–18 and 24mm from 0

This is known as the Linzemeier Tube, and is made in the United States by the Adams Glass Company

II The anticoagulant used is .2cc of a 3 6% solution of sodium citrate This alters the protoplasm little, if at all, and does not interfere with the citric acid cycle

III Silicon lined tubes accelerated the rate about 10–12 minutes regularly, and the information gained, although proving the fact of meniscus drag being lessened, did not warrant the extra effort needed to coat the tube

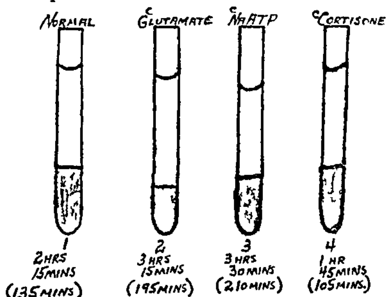
IV The blood is not refrigerated, as this would stop the protoplasmic activity, the whole operation is done at average room temperature

It must be stressed that blood (plasma and corpuscles) is living protoplasm, and because of its fluidity and the dynamic activity of its flow, it exerts enormous energy It is

still living protoplasm when we transfer it to the Linzemeier Tube and invert but do not shake it until well mixed

After standing and settling the tube contents may again be mixed with a gradual loss of energy and increasing rapidity of sedimentation

V *Reading the rate* The time required for the corpuscles to fall to the 18mm mark is taken as an average and in the normal individual is usually near 90–120 minutes The fall is not uniform it may start rapidly and then become slower but in the same individual in normal health it remains quite constant.



Tubes 2 and 3 show the effect of adding one milligram of energy rich substances definitely increasing the length of the sedimentation rate

Tube 4 as would be expected releases pent up energy and reduces the length of sedimentation

Chapter 5

THE SEDIMENTATION RATE AN ENERGY REACTION

The sedimentation rate of human blood corpuscles provides a remarkably accurate and very useful means of measuring *energy* exchange in both serum and corpuscles

Energy, in its various forms and with its many manifestations, is acquired—utilized in its ray form for the multitudinous activties of the protoplasm, or stored in its mass, as in structure and tissue formation

This constitutes the biologists' "form and function" As physiologists one attempts to interpret the function which leads to structure, as physicians, we must learn the normal protoplasmic activities, and then follow the deviations which disturb function as symptoms, or as in structural deformity, either gross or microscopic

The ancient philosophers were profoundly intrigued with the laws which governed the universe They became wonderful mathematicians and physicists, relying upon the "law" to prove "why" rather than "how"

They were interested in falling bodies and gravitation in the position of the bright stars the eclipse of the moon, the influence of the moon on the tides They applied their interpretations as far as possible to astronomy, to art and

painting, to chemistry, and to medicine and pharmacy No wonder that when certain predictions as to tides or eclipses came true that these philosophers were looked upon as in league with the lower regions No wonder they were driven from their homelands and, in some instances, lost their lives

It was whispered that these same alchemists attempted to transmute one metal into another—of all things—and the search was for gold They even knew that, in order to trigger off the reaction, a catalyst would be needed, and so a search for the philosopher's stone was begun

What then was lacking? The knowledge of energetics and the open system of dynamic equilibrium

Energetics Energy is the power to do work All forms are convertible and measured in work units, differing with the organ, with its kinetic activities, and whether in radiation or in substance as mass Sir Gowland Hopkins defined life as "kinetic equilibrium in a polyphasic system'

Dynamic equilibrium This brought us away from the idea of mass action of dilute salt solutions in a closed container

Martin Fischer told us years ago that, until we learned that the law of mass action in dilute saline solution in a closed system did not apply to colloidal solutions in an open system, we would make little progress By an "open system" we mean one or more stoma for intake, and one or more ports of excretion

Let us follow the phenomena of falling bodies into the blood where the corpuscles gravitate in a noncoagulated blood and which constitute the subject matter of our discussion, the sedimentation rate

The sedimentation of the corpuscles was known to the Greek physicians on the islands of Cos and Nidus, eighteen

centuries before Christ. They, however, looked upon the maintenance of the corpuscles as at a sustained level, a so-called "suspension stability." With disease, this stability was disturbed and the corpuscles fell more or less rapidly What would be more logical to them than to classify the fall into slow, moderate and fast, differing in degree?

Fahraeus introduced the single-hour reading in 1918, and this, coupled with the suspension-stability idea and associating different diseases with varying degrees of the rapidity of the fall from normal, led them into the error of stretching many points to fit their theories

What was the error? They did not know of the laws of energetics They did not know that in allergies we have one of the longest sedimentation rates In this country Schulhof published a paper showing the long sedimentation rates in allergies This was twenty-five years ago Martin Fischer said then that, until we recognized that the law of dilute solutions did not apply to colloidal solutions, we would make little progress The fall of the corpuscles is a gravitational exchange of energy in an open system; when for one reason or another a large amount of energy is produced and stored, we have an entirely different concept.

Going back to Fahraeus, let us tally the groups of the Greek physicians

A *No Increase in Sedimentation Rate*

Functional diseases What a large group to be so erroneously placed! The long sedimentation was mistaken for lack of sedimentation

Certain diseases of the nervous system, as dementia praecox

Focal infections, abscessed teeth, diseased tonsils (wrong).

Metabolic diseases, e g , uncomplicated diabetes and essential hypertension (only partly true, often not) Allergic diseases, asthma and hay fever (here they were 100% wrong) Again the long sedimentation rate was mistaken for stability

B *Little or No Increase in Sedimentation Rate*
Simple catarrhal inflammations, simple rhinitis, simple colitis, simple catarrhal appendicitis (wrong practically every one) Colitis, particularly, is prone to produce excess of antibodies and allergies with long sedimentation rates

C *Abnormally Rapid Sedimentation Rates*
Chronic infectious diseases, e g , tuberculosis and syphilis, (wrong in 95% of the cases) Mixed infection is often the cause of a rapid sedimentation rate
Acute infectious diseases, pneumonia (not so called virus pneumonia), septicemia endocarditis, acute exanthemata (not the virus type, as measles) and acute bronchitis—true
Malignancy—very true
Localized suppurations—true
Suppurative mastoiditis—true
Suppurative sinusitis—true
Bronchiectasis—true
Acute intoxications
Lead and arsenic poisoning
Certain endocrine disturbances
Thyroid toxicosis (this they questioned themselves) The rapid heart rate became a measure of Cocoas
Non reaginic allergies

What then led them astray? Answer a lack of knowledge

of energetics, the open or dynamic systems, and the colloidal state

The sedimentation of the erythrocytes is an energy-exchange proposition having to do with energy accepted and stored, as in the input of growth, expenditure, as in such work as maintaining body function, average body temperature and organ maintenance So it is that in health a fairly uniform sedimentation is maintained, often for years Any change or trend of change alerts us so that we may ascertain the cause But any acute infection or lytic or viral agent, with loss of energy, whether it be with heat-dissipating fever or without (as for example in tachycardia), accelerates the rate fall This accounts for the almost general use of the Westrobe Method which measures the distance the corpuscles fall in an hour Nothing is thought of what might happen if the distance were used in any contest and the speed of fall were timed This constitutes the rate we are talking about

Suppose the famouse horse Nashua were brought out for a mile and a half time trial and over the loudspeaker it was announced, "We will time the horse the way the physicians do their sedimentation rates, noting how far he goes in two minutes" The cheer that would go up would be loud, but it would be the Bronx cheer! Derby people know how to time a speed event

What happens if this energy is replaced by diminution of further expenditure the symptoms of diseases lessening or antibodies being formed to combat the antigen of disease? A chronic infection, with a constant production of lytic antigens, provokes the storage of reactive antibodies as energy and results in a long sedimentation rate

The longest sedimentation rates are found in the allergies where the energy stored is enormous

It is the photo electric response to an allergyn which triggers off one or several so called "allergic reactions" with release of energy These range from fever (although more often there is none) to muscular contraction, another form of energy release, as in bronchi or gut, to osmotic pressure changes causing more energy release, with allergic manifestations ranging from cloudy, swelling edema and pruritis to hives and fluid loss from mucous membrane, respiratory and G I particularly

One reaction which is used in describing the allergies and the long sedimentation rate is the production of histamine like bodies and their combat bodies, the immense group of antihistaminics

The first evidence came when histidine was decarboxylated by bacteria in acid media mostly in the intestine with *the formation of histamine and histamine-like alkaline toxic* material These include tyramine, histamine putrescine and cadaverine All are strongly basic and tend to neutralize the acidity of the medium in which they are produced

Animal tissues have few enzymes comparable with the bacterial decarboxylases, but these are also specific for a particular amino acid and are limited in number, mainly to tyrosine, histidine, and cysteic acid

We must consider that animal protoplasm contains some 10% of histidine, together with some twenty four other amino acid combinations Since these are specifically decarboxylated by bacteria in an acid medium, we see how broad a range is covered by the term "histamine like bodies

The sedimentation rate varies with altitude, (barometric pressure), with temperature, and with humidity, all of which can be demonstrated in the laboratory in an artificial climate with temperature, humidity, and barometric pressure controlled

SEDIMENTATION RATES AS INFLUENCED BY PRESSURE, HUMIDITY AND TEMPERATURE

TIMED IN MINUTES

Name	Date	Method Regular Sed Rate	Barometric Pressure Reduced One Inch	Humidity 98%	Humidity 58%	Humidity 15%
1 G O	'52	330		300	345	345
2.A I	'52	300	480	360	330	420
3.F K	'52	65	45	85	100	65
4.K G	'52	60	55	50	55	60
5 T C	'52	90	105	110	120	110
6 G.P	'52	210	160	195	150	140
7.R B	'52	330	120	170	130	130
8.L.B	'52	675	540	600	660	690
9 J R.	'53	315	175	225	135	200
10 W H	'53	90	45	50	65	55
11.A R	'53	240	195	195	210	195
12.J N	'53	225	240	225	285	235
13 V T	'53	600	570	540	480	510
14 V T	'53	420	340	355	380	330

Chapter 6

STRIKING DATA CONCERNING THE USE OF THE SEDIMENTATION RATE AND CORRELATED CONSTANTS IN DIAGNOSIS AND PROGNOSIS

Years ago the founder of the National Safety Council was a patient of mine He referred G H T, one of his top lieutenants, for periodic examination which are here recorded These findings are termed "physiological averages," and vary with race, color and geographic distribution of mankind, *but* once established in an individual, they become physiological constants and are maintained throughout the years unless subjected to interference from without or with in This will be seen by the change in 1948, when the patient had an emergency operation for acute appendicial abscess

This executive of The National Safety Council finds that safety measures should be extended to all executives, leaders from the President down

G H T

Specimen of feces of G H T Direct differential cultures how B coli communior 60%, and aerobacter aerogenes 40%, n addition, indirect shows B asiaticus Blood agar culture hows strep faecalis

June 4, 1956
M M Matthies

Date	3/27/31	5/25/36	10/2/48	9/7/51	10/18/52	5/28/56
Age	30	35	47	50	51	55
Weight	150	152	167.5	161	158	153
Height	68 7/8	69 7/8	70 1	69 1/4	69 1/4	69 1/4
Temp	98 6	98.2	98.2	98 2	98 4	98.4
Pulse	76	88	72	58-76	68	72
B. P	156/76/80 140/88/52	164/96/68	140/98/92	134/80/54	144/88/56	134/98/88
B M. R.	−2		−29 ?	−2	+11	+12
Pul. Capacity	4700 cc	4500 cc	4100 cc	4350 cc	4400 cc	4450 cc
Vital Capacity	100%	97%	80%	88%	90%	92%
Sed. Rate	20 hrs.	22 hrs.	1 hr	7 1/2 hrs.	7 hrs.	7 hrs.
Breath Held Before & After Deep Breathing			56 secs. 45 "	55.5 secs. 67.5 "	51 secs. 60 "	52.8 secs. 67 "
Vibrometer					100%	100%

To these findings I now add the following to complete the data and bring them up to the present

1) E K G
2) Blood group
3) Prothrombin time
4) Stool culture with autogenous vaccine to meet the influence of infection from within This autogenous vaccine is fortified and amplified by the addition of a small amount of the pool of intestinal organisms gathered the world over for a great many years

Chapter 7

THE VALUE OF THE SEDIMENTATION RATE TO THE POPULATION AT LARGE, SPECIFICALLY AS A MEASURE OF DAMAGE CAUSED BY ATOMIC FALLOUTS

The need for knowledge concerning the storage and release (or loss) of energy must be better understood and utilized

The atomic fallouts are identified by their effects These we can measure in humans *today* and now, not waiting for posterity Not only does the sedimentation rate, properly done and properly interpreted, measure the individual's susceptibility but also the damage done and how much resistance remains

For those who doubt the sedimentation rate alone, there are three corroborating tests on the same blood at the same time These are the viscosity of, and the total of, protein as well as the refractometric index of the plasma.

As an alarm reaction, the sedimentation rate alerts the population the *world over* concerning fallouts

Once an individual has been screened out by the rapidity of his sedimentation rate, the physiological average and the physiological indices point up the effects which show deviation from normal, which may be remedied, resisted, or made

more tolerable The worker can be removed from an industrial hazard, such as a product, solvent or dust In the case of executives, they may have plant hazards, as well as the stress of long hours and travel in many climates by various methods of locomotion This is truly an occupational hazard which cuts off the life of many a valuable man at an early age

The Wright interpretation, using the Linzemeier method, follows the recovery of energy by the lengthening of the rate This cannot be done if the Weintraub Method is used because it recognizes only the fall of the corpuscles and the loss of energy, but still adhering to the suspension stability of corpuscles, there is no measure of energy regained

The total protein, the viscosity, and the refractometric index follow the ups and downs of the rugged attempts to escape without genetic malformations

Thus, a modification of an old method plus a more accurate method of reading it as a rate, with a markedly different approach to energy acquisition and energy loss, may safeguard lives

IT SHOULD BE DONE!

Chapter 8

THE SEDIMENTATION RATE — IT HAS PROGNOSTIC VALUE

Years ago Sir Arthur Eddington called the law of thermodynamics "*time's arrow*." This then pointed to the *direction* of all real events in the universe in time (eventually, but with no inkling of the precise moment) when everything returned to that cosmic cloud from which all things come, but it gave no idea concerning the speed. Harold F. Blum, in his second volume,* brings the subject to the point where it can be understood by the clinician. We are interested in organic evolution, the living organisms—in this case, *man*.

If we refresh our memory, we come against the term "entropy," an energy term. Going further, we hear of "negative entropy," shown by the approach to Kelvin's 0° or −273°C, which is never entirely reached—one or more quanta are always active.

Complete entropy is the converse, with the scattering of the quanta until they return to the godhead from which energy emanated. This is the directional time's arrow of Eddington. Eddington's time's arrow is universal, be-

* Harold F. Blum: *Time's Arrow and Evolution*, 1955, Princeton University Press.

ginning at Kelvin's 0° (−273°C) and ending in complete dissolution The organic, man sedimentation rate averages (timed) 90 minutes, begins at 0 and ends at 18mm If below 90 minutes, energy is lost

Concerning the time element and prognostic application of time's arrow to man the sedimentation rate is a measure of energy loss—in this case, *in time,* since it is a rate The amount of energy dissipated increases the entropy, and we *have the time-space continuum as it applies to a particular* individual at a given time

This I find of great value in checking high powered executives who are flirting with disaster Here I follow with prothrombin time estimations This is another energy rate determination which is mistakenly translated into an amount of prothrombin If the reading is very short, the patient is hospitalized and given oral anticoagulant therapy under daily or twice-daily prothrombin readings

Once a crisis of this sort is avoided and understood, the fear of a sudden holiday wrecking demise or stroke paralyzing speech and locomotion can be circumvented

Now with the new group of pressure-reducing galenicals, using various fractions of rauwolfia serpentina, the pressure can be held at a safe level, while the flora of the intestine is corrected and any blood dyscrasias modified

This is to promote a better understanding of the energetics of the sedimentation rate

The sedimentation rate, if timed correctly, fulfills the *specifications of H G Wells* "time machine" Once an individual has his sedimentation rate established, it remains a physiological constant for years

POSTSCRIPT

By means of the sedimentation rate I can measure the energy poured down upon individuals from far ranging distant bomb blasts in its effect upon the dynamic activities of individual human cells

I have shown you three graphic proofs of these 1) The blast at Eniwetok with its terrifying power The controversial fallouts were in the Marshall area, please be reminded 2) Some reproductions of moving film frames, showing active leukocytes I have a whole reel of these showing active leukocytes, dying cells, and lifeless ones all in one field 3) Lastly, I have a quote and one symbol that appeals to the eye This book is packed with "~" information The symbol is used by chemists to denote "energy rich"

I was horrified to learn that this (my) country had moved its aerial nuclear tests back to Eniwetok, and what is worse was to detonate under water and deep in the earth The arrogance of ignorance is terrifying—and I believe that God in his wisdom will not permit either a single and very narrow minded individual, or a group, to cause mass murder in a group of friendly nations

It takes time to attain useful knowledge, often a lifetime As a youngster, when walking down the Burlington rail

road tracks on my way to the old swimming hole, I could see 'Old 156" pulling out of Sandwich and giving two long and two short whistles as she approached a road crossing just outside of town What impressed me was that the sound followed so long after the steam jets

Knowing nothing of the speed of sight (light) I was greatly impressed by the slowness of sound

The swimming hole was just south of the bridge where Somonauk Creek serpentined its way around, coming back to a high bank on the west side The stream had undercut this bank, causing a large tree to fall across the creek The roots let me down to the large bole which made a bridge across the creek, and there I learned to swim—first dog fashion later breast stroke—and finally to dive Then when face and ears were immersed, I learned about the effect of sound transmission in water *All an unfriendly youngster had to do was to pound two rocks together the ear splitting re*sult would bring up the surprised swimmer treading water to get away from the pain The same swimming hole froze over earlier in the winter, and the ice was thicker and remained longer in the spring This was much different from the rapid running water farther downstream

Years later I visited the old swimming hole on Sunday *By that time I had learned of the clotting of hemoconcen*trated blood in the angulations of the coronary and cerebral vessels Lying there, I shuddered to think that today, instead of the noise of rocks being pounded the percussions were in megatons and accompanied by lethal radar like waves over an ocean

History cannot be evaded Following the first nuclear *splitting in Stagg Field, by products* of great lethal power had to be disposed of Dumping in Bubbly Creek near the stockyards was quickly Geiger counted out, as was a naked

burial in the earth A rough box of concrete was made to allow decay of this horrendous residue

History does not tell us if a decent burial in a heavy lead casket followed (gangsters have gold lined and prelates, zinc lined caskets) Nor does history tell whether Fermi's days were cut short by the modern Frankenstein he fathered

Some years later I again visited the old swimming hole, as I was lying on its banks, this thought came to me The University of Hawaii is a modern Tower of Babel keeping alive and using the languages and songs of the island groups of Oceania—Polynesia, Micronesia and Melanesia, reaching to the southern boundaries of both Japan and China And so, as the teachings of Jesus, who lived on the shores of one sea, are spread to the Seven Seas, surely his Gospel will be heard

If it be that the teachings of this book are added as a corollary to the down to-earth attack upon this controversial problem, true betterment of international relations will surely follow

Somonauk Creek may be a modern counterpart of Walden Pond

This is my belief and my humble prayer

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RANK WRIGHT, M.D., F.A.C.P., F.A.S.

Author of

THE SEDIMENTATION RATE
OF HUMAN ERYTHROCYTES



A Plea for Cybernetics

A penchant for securing information at its source, men, books, or places A Nova Scotia high school teacher, Swinton's Word Analysis and coaching *for* a county teacher's certificate

A course in Stoichiometry, Oldberg's Home Study in Pharmacy *a chapter on crystal formation.*

A weekly session operating an old hand press, putting out the local "Reveille" In this he wrote what purported to be a trip to the famous cathedrals of the old world

Arriving at Northwestern University School of Pharmacy with insufficient funds to carry through the year, the Dean referred him to a member of the State Board of Pharmacy to do relief work while he prepared for registration and earned enough to carry on At year's end, he received the University Medal and an appointment as Amanu ensis in the botanical laboratory Here he came under William K *Higley and became proficient in microscopic technique*

Entering the second year for the PhC degree, brought him under the tutelage of Dr John H Long, at that time President of the American Chemical Society and Jan B Nagelvoort, an alkaloidal chemist brought on from Parke Davis and Company

Dr Long took the appointment as chemist for the State Board of Health to give him the appointment as assistant, and for two years *the analysis of the water supply before and after the drainage* canal was opened The water was shipped from Lake Michigan Crib, the Chicago River and the canal at Lockport, then the Illinois River and its tributaries, *to* its junction with the Missouri and the Mississippi well below St Louis This included bacterial counts with Dr F Robert Zeit While this delayed the PhC degree for another year, it allowed time for classes at Kenwood Preparatory School in mathematics, French and German Dr Long, then President of the American Chemical Society, was translating Landolt's work on Optical Rotation of Organic Substances Each substance was not only rechecked, thus giving unusual proficiency in this difficult procedure, but the purity *of* the organic *substances was recapped.* Gravity,

He had attempted to be well informed and one day a Frenchman, named LeBlanc, was sent to his office to give his summing up of a mutual patient. He came from Elgin and began talking about protein particles and aggregates, about active motion of these particles and the leukocytes which also contained the same particles. Needless to say on the following Sunday taking his assistant with him, he motored to Elgin and for the first time saw a dark field with the activity of the aggregates outside and inside the leukocytes

The amoeboid like mobility of the leukocytes fascinated him, while the empty space replacing the nucleus raised a question which is important to this day That day he first learned that the sedimentation rate of the blood and the viscosity of the serum were tied to the colloidal picture.

This hematology meant new instruments, and new explanations of the findings

The first project was to obtain the best type of dark field condensor For daily routine examinations, a paraboloid type sufficed and is still used, but later when a large Leitz scope was used for recording the activities on a movie film, a cardioid condensor was used For these projections he coined the term Micro-metabolism, for these activities thrown on a screen allowed study and interpretation not caught by the eye alone.

To learn of the sedimentation rate technique at first a number of narrow tubes were used, but he fortunately settled on the old Linzenmeier tube with citrate used as an anticoagulant. This disturbs the citric acid cycle very little

Securing a viscosimeter was a problem Made by Hess in Switzerland, an optical firm Contact was made through the purchasing agent of the TWA Air Lines Arriving at customs in Chicago the question arose, if an optical instrument the duty was many times greater than if a scientific instrument When satisfactorily settled, he became the possessor of three of the four viscosimeters in the country

After becoming proficient in the use and findings of the dark field he felt that these should be recorded on a movie film if possible

Assembling a group, the first, an electrician, rigged up a carbon arc light which was sent through a liter flask to cool and at the same time to act as a lens. Next through a two-inch water cell to further cool it before it reached the substage mirror Next, an expert microscopist who could adjust the tricky cardioid condensor Lastly, a top expert from Bell & Howell who arranged a reflector and finder so the image could be projected laterally to a 16mm movie camera with the lens removed. Along this line a space was arranged to follow

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field and as soon as a spot was needed, the light sent to the cam which was turned on. To eliminate vibration, the whole appara was mounted on a two-inch marble slab atop two thicknesses of ho collar felt. Thousands of feet of film were wasted, but eventually range was found that when edited showed a new world in Mic metabolism.

Years of study brought out new findings that were there but the meaning was gradually being revealed.

Correlating the findings with the physical measurements was a ways stressed and the latter has proved its worth. The pictures sho the activity, the dynamics, and the measurements for the first tim and prove that one can measure energy in more than its usual form